

Determination of Asbestos in Mortar Admixture by TG-DTA

A notification issued by Japan's Ministry of Health, Labour and Welfare in July 2004 entitled "Prevention of Asbestos Exposure in Serpentine Mortar Admixture" stipulates that differential thermogravimetry (D-TG) is effective for analyzing serpentine rock used in mortar admixtures.

In plastering work, ground serpentine rock mortar admixture is used to increase the workability of a coating. Serpentine, the principal ingredient of serpentine rock, includes chrysotile that is asbestos, as well as non-asbestos antigorite and lizardite. When using a mortar admixture, it is necessary to confirm the presence of asbestos, or chrysotile. If the use of serpentine rock is confirmed by X-ray diffraction analysis, then it is necessary to confirm the presence of chrysotile by D-TG.



Fig. 1 DTG-60/DTG-60H

■ Determination Method

First, the presence of serpentine rock is confirmed by X-ray diffraction analysis. If no serpentine rock is detected, D-TG is not required. If the presence of serpentine rock is confirmed, then it is necessary to determine the type of serpentine. The three kinds of serpentine, chrysotile, antigorite and lizardite, have similar chemical compositions and crystal structures. In X-ray diffraction patterns, all of them show large peaks in the vicinity of 12° and 24° , and the difference is with the appearance of small peaks at about $35 - 36^\circ$. However, since the chrysotile peak intensity is weaker than that of antigorite and lizardite, the presence of chrysotile cannot be confirmed if two or three of them exist. Thus D-TG is effective in confirming the presence of chrysotile.

The chemical composition of the serpentine varieties are all the same: $Mg_2Si_2O_5(OH)_4$. The $(OH)_4$ corresponds to water of crystallization, which dehydrates at $600 - 800^\circ\text{C}$. That temperature is in the range of $630 - 680^\circ\text{C}$ for lizardite, $650 - 700^\circ\text{C}$ for antigorite, and $750 - 800^\circ\text{C}$ for chrysotile. The dehydration is measured with a thermogravimetric (TG) analyzer, and the presence of chrysotile (asbestos) is confirmed by the differences in peak temperature in the differential thermogravimetric (D-TG) curve obtained by differentiating the TG curve showing the changes in weight. This is the differential thermogravimetric (D-TG) analysis.

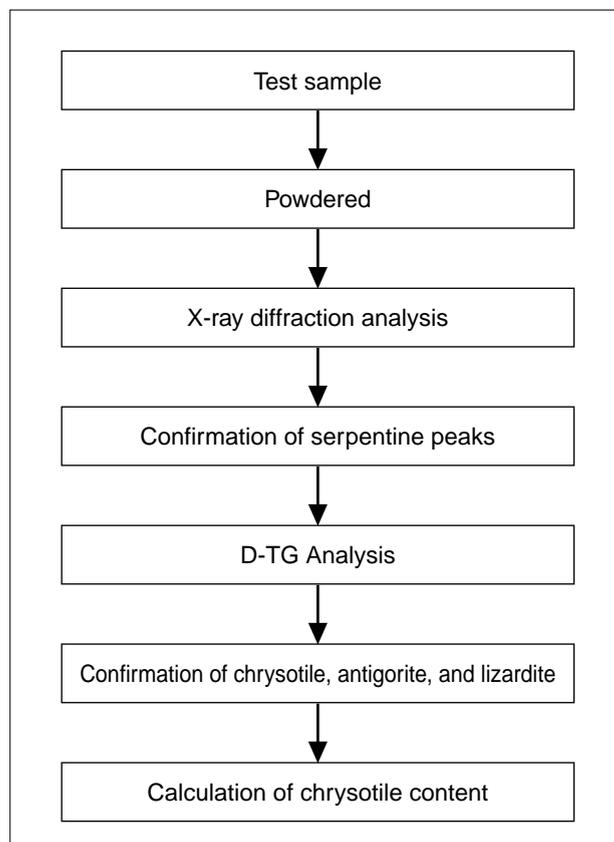


Fig. 2 Determination of Chrysotile in Serpentine Rock

■ Measurement of Chrysotile and Antigorite

Fig.3 shows the measurement result where approximately 20mg of ground samples are heated at a rate of 20°C/min. The changes due to crystal water dehydration can be observed. The peak temperature of the chrysotile D-TG curve is 680°C, while that of

antigorite is 760°C. The "TG" lines (broken lines) represent the changes in weight. The D-TG curves (solid lines) represent the result of differentiation of the weight change, which is specified in the ministry notification.

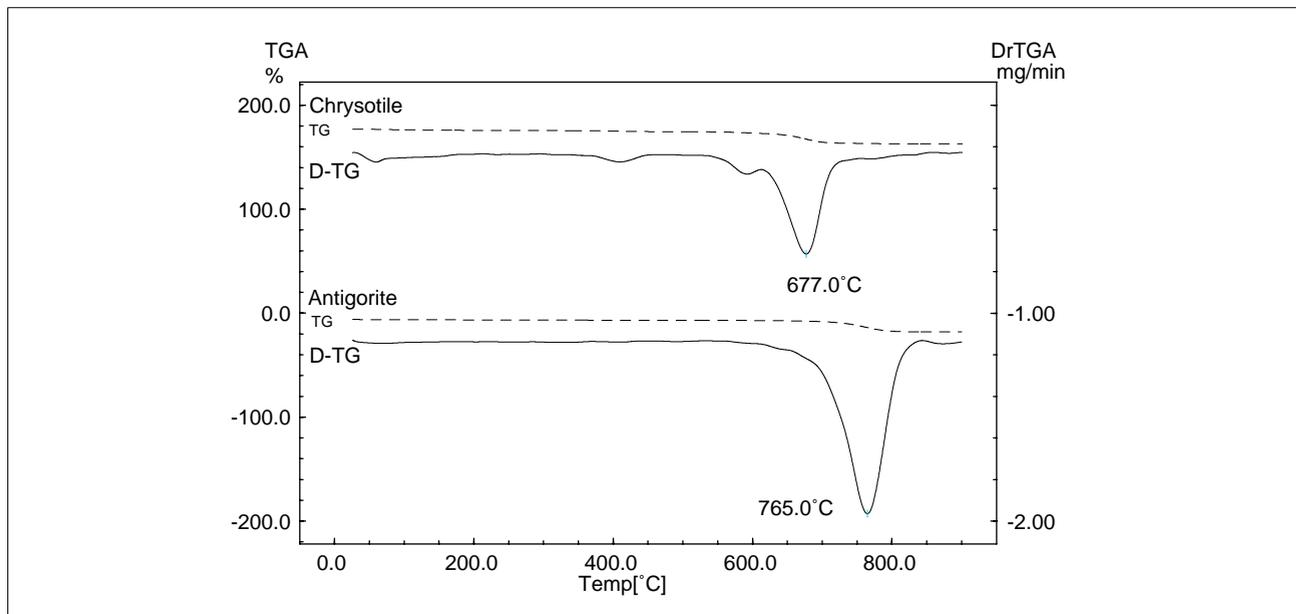


Fig. 3 Measurement of Chrysotile and Antigorite

■ D-TG Measurement of Mortar Admixture

Mortar admixtures where the serpentine peaks were detected by X-ray diffraction analysis were further subjected to D-TG analysis. The samples show peaks in the vicinities of 650°C and 770 - 780°C, which indicate the existence of chrysotile and antigorite

respectively. Sample C shows a large peak near 650°C, which indicates the presence of a large quantity of chrysotile. The content of each component can be quantified by obtaining the peak area.

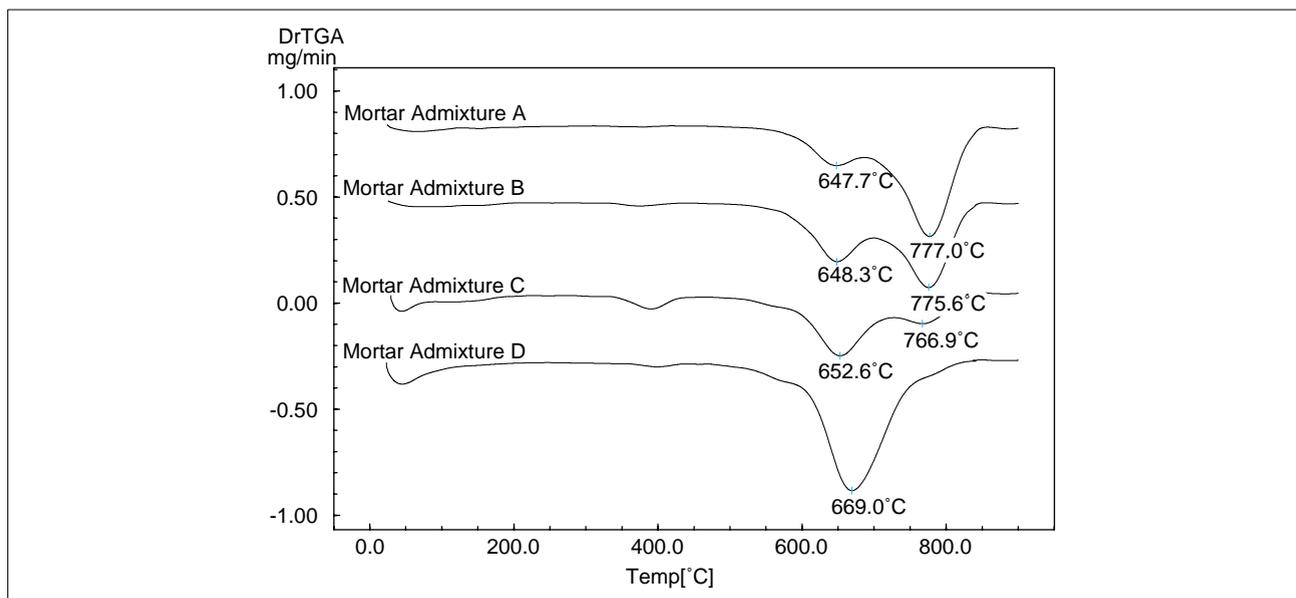


Fig. 4 Measurement of Mortar Admixtures



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